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Marine Biodiversity

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Summaries and Reviews:

- Chapin, F.S. III et al. 2000. Consequences of changing biodiversity. *Nature* 405:234-242.
- Costanza, R., M. Kemp, and W. Boynton. 1995. Scale and biodiversity in coastal and estuarine ecosystems. Pages 84-125 in: Perrings, C. et al. (Editors). *Biodiversity loss. Economic and ecological issues*. Cambridge University Press.
- Huston, M. 1994. *Biological Diversity. The Coexistence of Species on Changing Landscapes*. Cambridge University Press, Cambridge.
- May, R.M. 1994. Biological diversity: differences between land and sea. *Philosophical Transactions of the Royal Society of London, Series B* 343:105-111.
- Ormond, R.F.G., J.D. Gage, and M.V. Angel (eds). *Marine Biodiversity. Patterns and Processes*. Cambridge University Press, Cambridge, UK.
- Reaka-Kudla, M.L. 1997. The global biodiversity of coral reefs: a comparison with rain forests. Pp 83-108 in: Reaka-Kudla, M.L., D.E. Wilson, and E.O. Wilson (eds). *Biodiversity II*. Joseph Henry Press, Washington DC.
- Ricklefs, R.E. 1987. Community diversity: relative roles of local and regional processes. *Science* 235:167-171.
- Sala, O.E. et al. 2000. Global biodiversity scenarios for the year 2000. *Science* 287:1770-1774.

Evolutionary origins of biodiversity:

- Fischer, A. G. 1960. Latitudinal variations in organic diversity. *Evolution* 14:64-81.
- Jablonski, D. 1993. The tropics as a source of evolutionary novelty through geologic time. *Nature* 364:142-144.
- Jablonski, D. and D.J. Bottjer. 1991. Environmental patterns in the origins of higher taxa: the post-Paleozoic fossil record. *Science* 252:1831-1833.
- Miya, M. and M. Nishida. 1997. Speciation in the open ocean. *Nature* 389:803-804.
- Palumbi, S.R. 1992. Speciation on a small planet. *Trends in Ecology and Evolution*
- Palumbi, S.R. 1994. Genetic divergence, reproductive isolation, and marine speciation. *Annual Review of Ecology and Systematics* 25:547-572.
- Vermeij, G.J. 1992. Time of origin and biogeographical history of specialized relationships between northern marine plants and herbivorous molluscs. *Evolution* 46:657-664.

Maintenance of biodiversity in communities—Classics:

- Connell, J.H. 1978. Diversity in tropical rain forests and coral reefs. *Science* 199:1302-1309.
- Dayton, P.K. 1971. Competition, disturbance, and community organization: the provision and subsequent utilization of space in a rocky intertidal community. *Ecological Monographs* 41:351-389.
- Hairston, N. G., F. E. Smith and L. G. Slobodkin. 1960. Community structure, population control, and competition. *American Naturalist* 94:421-425.
- Hay, M.E. 1981. Herbivory, algal distribution, and the maintenance of between-habitat diversity on a tropical fringing reef. *American Naturalist* 118:520-540.
- Hessler, R.R. and H.L. Sanders. 1967. Faunal diversity in the deep sea. *Deep-Sea Research* 14:65-78.
- Hutchinson, G.E. 1959. Homage to Santa Rosalia: or, why are there so many kinds of animals? *American Naturalist* 93:145-159.
- Hutchinson, G.E. 1961. The paradox of the plankton. *American Naturalist* 95:137-145
- Lubchenco, J. L. 1978. Plant species diversity in a marine intertidal community: importance of herbivore food preference and algal competitive abilities. *American Naturalist* 112:23-39.
- Menge, B.A. and J.P. Sutherland. 1976. Species diversity gradients: synthesis of the roles of predation, competition, and temporal heterogeneity. *American Naturalist* 110:351-369.
- Paine, R. T. 1966. Food web complexity and species diversity. *American Naturalist* 100:65-75.
- Sanders, H. L. 1968. Marine benthic diversity: a comparative study. *Am. Nat.* 102:243-282.

Maintenance of biodiversity in communities—Continued:

- Agard, J.B.R., R.H. Hubbard, and J.K. Griffith. 1996. The relation between productivity, disturbance and the biodiversity of Caribbean phytoplankton: applicability of Huston's dynamic equilibrium model. *Journal of Experimental Marine Biology and Ecology* 202:1-17.
- Bellwood, DR; Hughes, TP. 2001. Regional-scale assembly rules and biodiversity of coral reefs. *Science* 292:1532-1534.
- Bertness, MD. 1984. Habitat and community modification by an introduced herbivorous snail. *Ecology* 65:370-381.
- Bertness, M.D. and A.M. Ellison. 1987. Determinants of pattern in a New England salt marsh plant community. *Ecological Monographs* 57:129-147.
- Cornell, H. V. and R. H. Karlson. 1996. Species richness of reef-building corals determined by local and regional processes. *Journal of Animal Ecology* 65:233-241.
- Cronin, T.M. and M.E. Raymo. 1997. Orbital forcing of deep-sea benthic species diversity. *Nature* 385:624-627.
- Etter, R.J. and J.F. Grassle. 1992. Patterns of species diversity in the deep sea as a function of sediment particle size diversity. *Nature* 360:576-578.
- France, R. and C. Rigg. 1998. Examination of the 'founder effect' in biodiversity research: patterns and imbalances in the published literature. *Diversity and Distributions* 4:77-86.

- Gee, J. M. and R. M. Warwick. 1996. A study of global biodiversity patterns in the marine motile fauna of hard substrata. *Journal of the Marine Biological Association of the United Kingdom* 76:177-184.
- Grassle, J.F. and N. Maciolek. 1992. Deep-sea species richness: regional and local diversity estimates from quantitative bottom samples. *American Naturalist* 139:313-341.
- Hacker, S.D. and M.D. Bertness. 1999. Experimental evidence for factors maintaining plant species diversity in a New England salt marsh. *Ecology* 80:2064-2073.
- Levin, P.S., J. Ellis, R. Petrik, and M.E. Hay. 2002. Indirect Effects of Feral Horses on Estuarine Communities. *Conservation Biology* 16:1364-1371.
- McGowan, J.A. and P.W. Walker. 1985. Dominance and diversity maintenance in an oceanic ecosystem. *Ecological Monographs* 55:103-118.
- Menge, B. A. and A. M. Olson. 1990. Role of scale and environmental factors in regulation of community structure. *Trends in Ecology & Evolution* 5:52-57.
- Raffaelli, D. 2000. Trends in research on shallow water food webs. *Journal of Experimental Marine Biology and Ecology* 250:223-232.
- Rex, M.A. 1981. Community structure in the deep-sea benthos. *Annual Review of Ecology and Systematics* 12:331-353.
- Rex, M.A., C.T. Stuart, R.R. Hessler, J.A. Allen, H.L. Sanders, and G.D.F. Wilson. 1993. Global-scale patterns of species diversity in the deep-sea benthos. *Nature* 365:636-639.
- Sommer, U. 1994. The impact of light intensity and daylength on silicate and nitrate competition among marine phytoplankton. *Limnology and Oceanography* 39:1680-1688.
- Steele, J.H. 1991. Marine functional diversity. *BioScience* 41:470-474.
- Verity, P.G. and V. Smetacek. 1996. Organism life cycles, predation, and the structure of marine pelagic ecosystems. *Marine Ecology Progress Series* 130:277-293

Biodiversity and (mostly marine) ecosystem functioning:

- Allison, G. W. 1999. The implications of experimental design for biodiversity manipulations. *American Naturalist* 153:25-45.
- Biles, C.L., M. Solan, I. Isaksson, D.M. Paterson, C. Eames, and D.G. Raffaelli. 2003. Flow modifies the effect of biodiversity on ecosystem functioning: an in situ study of estuarine sediments. *Journal of Experimental Marine Biology and Ecology* 285/286:165-177.
- Bolam, S.G., T.F. Fernandes, and M. Huxham. 2002. Diversity, biomass, and ecosystem processes in the marine benthos. *Ecological Monographs* 72:599-615.
- Carr, M.H., T.W. Anderson, and M.A. Hixon. 2002. Biodiversity, population regulation, and the stability of coral-reef fish communities. *Proceedings of the National Academy of Sciences USA* 99:11241-11245.
- Cottingham, K. L., B. L. Brown, J. T. and Lennon. 2001. Biodiversity may regulate the temporal variability of ecological systems. *Ecology Letters* 4:72-85.
- Duarte, C. M. 2000. Marine biodiversity and ecosystem services: an elusive link. *Journal of Experimental Marine Biology and Ecology* 250:117-131.

- Duffy, J. E. 2002. Biodiversity and ecosystem function: the consumer connection. *Oikos* 99:201-219.
- Duffy, J. E. 2003. Biodiversity loss, trophic skew, and ecosystem functioning. *Ecology Letters* 6:680-687.
- Duffy, J. E., J. P. Richardson, and E. A. Canuel. 2003. Grazer diversity effects on ecosystem functioning in seagrass beds. *Ecology Letters* 6:637-645
- Elmqvist, T. et al. 2003. Response diversity, ecosystem change, and resilience. *Frontiers in Ecology and the Environment* 1:488-494.
- Emmerson M. and M. Huxham. 2002. How can marine ecology contribute to the biodiversity-ecosystem functioning debate? In: Loreau, M., S. Naeem, and P. Inchausti (eds). *Biodiversity and ecosystem functioning*. Oxford University Press, New York. pp. 139-146.
- Emmerson, M.C., M. Solan, C. Emes, D.M. Paterson, and D. Raffaelli. 2001. Consistent patterns and the idiosyncratic effects of biodiversity in marine ecosystems. *Nature* 411:73-77.
- Giller, P., and 11 others. 2004. Biodiversity effects on ecosystem functioning: emerging issues and their experimental test in aquatic environments. *Oikos*, *in press*.
- Hilborn, R., T.P. Quinn, D.E. Schindler, and D.E. Rogers. 2003. Biocomplexity and fisheries sustainability. *Proceedings of the National Academy of Sciences USA* 100:6564-6568.
- Hulot, F.D., G. Lacroix, F. Lescher-Moutoué, and M. Loreau. 2000. Functional diversity governs ecosystem response to nutrient enrichment. *Nature* 405:340-344.
- Lawton, J.H. 1994. What do species do in ecosystems? *Oikos* 71:367-374.
- Loreau, M., Naeem, S., Inchausti, P., Bengtsson, J., Grime, J.P., Hector, A., Hooper, D.U., Huston, M.A., Raffaelli, D., Schmid, B., Tilman, D., and Wardle, D.A. 2001. Biodiversity and ecosystem functioning: current knowledge and future challenges. *Science* 294:804-808.
- Loreau, M., S. Naeem, and P. Inchausti. 2002. *Biodiversity and ecosystem functioning*. Oxford University Press, New York.
- Naeem, S., Thompson, L.J., Lawler, S.P., Lawton, J.H., and Woodfin, R.M.. 1994. Declining biodiversity can alter the performance of ecosystems. *Nature* 368:734-737.
- Raffaelli, D., M. Emmerson, M. Solan, C. Biles, and D. Paterson. 2002. Biodiversity and ecosystem processes in shallow coastal waters: an experimental approach. *Journal of Sea Research* 316:1-9.
- Schindler, D. E., S.R. Carpenter, J.J. Cole, J.F. Kitchell, and M.L. Pace. 1997. Influence of food web structure on carbon exchange between lakes and the atmosphere. *Science* 277:248-251.
- Schmid, B., J. Joshi and F. Schläpfer. 2002. Empirical evidence for biodiversity-ecosystem functioning relationships. In: Kinzig, A. P., S.W. Pacala and D. Tilman. *The Functional Consequences of Biodiversity*. Princeton University Press, Princeton, pp. 120-150.
- Srivastava, D.S. 2002. The role of conservation in expanding biodiversity research. *Oikos* 98:351-360.
- Stachowicz, J.J., R.B. Whitlatch, and R.W. Osman. 1999. Species diversity and invasion resistance in a marine ecosystem. *Science* 286:1577-1579.
- Stachowicz, J.J., Fried, H., Osman, R.W., and Whitlatch, R.B. 2002. Biodiversity, invasion resistance, and marine ecosystem function: Reconciling pattern and process. *Ecology* 83:2575-2590.

- Thébault, E. and M. Loreau. 2003. Food-web constraints on biodiversity-ecosystem functioning relationships. *Proceedings of the National Academy of Sciences USA* 100:14949-14954.
- Tilman, D. 1999. The ecological consequences of changes in biodiversity: a search for general principles. *Ecology* 80:1455-1474.
- Worm, B. and J.E. Duffy. 2003. Biodiversity, productivity, and stability in real food webs. *Trends in Ecology and Evolution* 18:628-632.
- Worm, B., H. K. Lotze, H. Hillebrand, and U. Sommer. 2002. Consumer versus resource control of species diversity and ecosystem functioning. *Nature* 417:848-851.

Biodiversity and Conservation:

- Brailovskaya, T. 1998. Obstacles to Protecting Marine Biodiversity through Marine Wilderness Preservation: Examples from the New England Region. *Conservation Biology* 12: 1236-1240.
- Costanza, R. et al. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387:253-260.
- Dayton, P.K. 2003. The importance of the natural sciences to conservation. *American Naturalist* 162:1-14.
- Duarte, C.M. 2002. The future of seagrass meadows. *Environmental Conservation* 29: 192-206.
- Hughes, T.P. 1994. Catastrophes, phase shifts, and large-scale degradation of a Caribbean coral reef. *Science* 265:1547-1551.
- Hughes, TP; Bellwood, DR; Connolly, SR. 2002. Biodiversity hotspots, centres of endemism, and the conservation of coral reefs. *Ecology Letters* 5:775-784.
- Jackson, J.B.C. 1997. Reefs before Columbus. *Coral Reefs* 16, Supplement: S23-S32.
- Jackson, J. B. C., M. X. Kirby, W. H. Berger, K. A. Bjorndal, L. W. Botsford, B. J. Bourque, R. H. Bradbury, R. Cooke, J. Erlanson, J. A. Estes, T. P. Hughes, S. Kidwell, C. B. Lange, H. S. Lenihan, J. M. Pandolfi, C. H. Peterson, R. S. Steneck, M. J. Tegner, and R. R. Warner. 2001. Historical overfishing and the recent collapse of coastal ecosystems. *Science* 293:629-638.
- Janzen, D.H. 1986. The future of tropical ecology. *Annual Review of Ecology and Systematics* 17:305-324.
- Lawton, J.H. 1991. Are species useful? *Oikos* 62:3-4.
- Mckinney, M.L. 1998. Is marine biodiversity at less risk? Evidence and implications. *Diversity and Distributions* 4:3-8.
- Myers, N., R.A. Mittermeier, C.G. Mittermeier, G.A.B. da Fonseca, and K. Kent. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403:853-858.
- Myers, R. A. and B.Worm. 2003. Rapid worldwide depletion of predatory fish communities. *Nature* 423:280-283.
- Pauly, D., V. Christensen, J. Dalsgaard, R. Froese, and F. Torres, Jr. 1998. Fishing Down Marine Food Webs. *Science* 279:860-863.
- Roberts, C.M. and J.P. Hawkins. 1999. Extinction risk in the sea. *Trends in ecology and Evolution* 14:241-245.

- Roberts, CM; McClean, CJ; Veron, JEN; Hawkins, JP; Allen, GR; McAllister, DE; Mittermeier, CG; Schueler, FW; Spalding, M; Wells, F; Vynne, C; Werner, TB. Marine Biodiversity Hotspots and Conservation Priorities for Tropical Reefs. *Science* 295:1280-1284.
- Roberts, CM; Andelman, S; Branch, G; Bustamante, RH; Castilla, JC; Dugan, J; Halpern, BS; Lafferty, KD; Leslie, H; Lubchenco, J; McArdle, D; Possingham, HP; Ruckelshaus, M; Warner, RR. 2003. Ecological criteria for evaluating candidate sites for marine reserves. *Ecological Applications* 13 suppl:S199-S214.
- Sax, D.F. and S.D. Gaines. 2003. Species diversity: from global decreases to local increases. *Trends in Ecology and Evolution* 18:561-566.
- Verity, P.G., V. Smetacek, and T.J. Smayda. 2002. Status, trends and the future of the marine pelagic ecosystem. *Environmental Conservation* 29:207-237.
- Wolff, W.J. 2000. Causes of extirpations in the Wadden Sea, an estuarine area in the Netherlands. *Conservation Biology* 14:876-885.

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